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Prenatal diagnosis using sonographic guided cordocentesis

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1 Introduction

Cordocentesis for prenatal diagnostic purposes has been already considered and experienced during the seventies while performing fetoscopy. The crucial argument for the generally agreement of non-acceptance of this technique was the relatively extremely high incidence of termination of the pregnancy as a complication of the procedure (up to 11.3%) [24]. This major complication made fetoscopy to be practiced only by minor groups of perinatologists.

In 1983 the first cordocentesis under real-time ultrasonic guidance was described [3]. Since then the technique has been practiced all over the world as a diagnostic tool for intrauterine infections [5, 12], hematological disorders [1, 2, 3, 5, 7, 12, 14], metabolic status and blood gases of the fetus [1, 12, 15, 18] and rapid cytogenetic analysis [1, 5, 12, 20].

The purpose of this paper is to report our experience in performing this method for prenatal diagnosis over the last three years.

2 Materials and methods

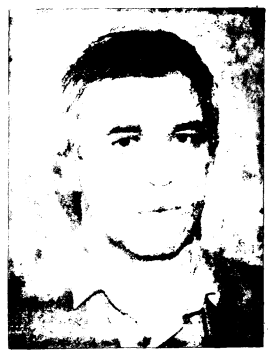
Between December 1985 and December 1988 one hundred and ninety eight (198) cordocentesis were performed in an ambulatory program.

Preliminary maternal blood analysis includes: blood group, Rh factor and mean corpuscular volume (mcv). An ultrasonic screening of all fetal organs is performed prior to the final determination of the umbilical-cord insertion-sight into the placenta. After cleaning the abdomen with Iodine solution, the ultrasonic (3.5 mHz) transducer is being held in a sterile nylon bag and a repeated focusing of the insertion point is made (using sterile gel for the transducer).

A 21 gauge spinal needle, previously washed with heparin or citrate, is inserted via the optimal point on the maternal abdomen. Under real time ultrasonic guidance it is possible to follow the needle to the exact puncturing sight. An assistant must aid in aspirating the fetal blood while the needle is being located in the umbilical vessel. An immediate blood analysis is being performed for mcv of the erythrocytes, in purpose to fully confirm that fetal blood has been aspirated.

Fetal monitoring routinely follows cordocentesis: ultrasonic real-time fetal heart and body movements visualization, and NST at gestational age more than 26 weeks.

Curriculum vitae



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3 Results

198 cordocentesis are described in this study. Successful cordocentesis were achieved upon first puncture in 191 out of 201 cases (95.0%) and in 7 out of 10 in second puncture. No more than two punctures were performed; thus, successful cordocentesis were achieved in 198 out of 201 cases (98.5%). The distribution of cases according to gestational age is presented in table I. 66.4% of the cases (132 out of 198) were performed between ninteenth to twenty-forth week of gestation. The spectrum of indications for the procedure is presented in table II.

Table I. Distribution of cases according to gestational weeks

Gestational week	Number of cases
19–21	54
22–24	78
25–27	49
28–30	9
31–33	7
34	1
Total	198

Karyotyping performed to 175 cases revealed 39 cases of chromosomal abnormalities. Fetal metabolic status was analysed in seven preterm cases where either severe IUGR and oligohydramnios or pathological NST indicated the need for rapid results. Four blood samples confirmed fetal distress and the other three were within normal values.

The procedure was successfully performed within seven minutes, in average, for the first 30 cases (minimal time: three minutes; maximal time: fourteen minutes). The time required for performing the procedure was dramatically reduced in the consequent 70 cases: average time required was two minutes (minimal time: 40 seconds; maximal time: six minutes). Bleeding of the puncturing site was noted in 38% of the cases, but never was demonstrated to last more than 90 seconds. No pathological pattern of fetal NST was seen upon accomplishment of the procedure in any of the cases. In a small minority of cases (12) transient fetal bradicardia was demonstrated on the ultrasound screen, but in all cases the following NST was normal.

Termination of the pregnancy was directly related to the procedure itself in only two cases (1.0%). In a case where cytogenetic analysis revealed Trisomy 21, septic fever was noted three days after the cordocentesis. In the second case premature rupture of the membranes occured ten days after the cordocentesis accompanied by premature contractions. Considering the premature gestational age (23rd week), tocolysis was

Table II. List of indication for cordocentesis and laboratory analysis

Indication	Laboratory analysis	Number of cases
Late counceling	karyotype	23
Failure in tissue culturing	karyotype	12
Mosaicism in amniotic fluid	karyotype	13
Amniotic-fluid pathology	karyotype	18
Fragile x	karyotype	5
Structural anomaly demonstrated in an ultrasound examination	karyotype	76
IUGR	karyotype	27
Fetal distress	acid/base	7
ITP	platelet count	3
Glantzman disease	Anti-gp IIB/IIIa Ab	1
Preotein C defficiency	protein c	1
Beta-thalassemia	Hb analysis	9
Hemophilia	factor eight	1
Cystic fibrosis	Gene No. 7	1
Cytochrome C Oxidase Defficiency	lactate	1
Total		198

not started and the neonate born (370 gr) died after two hours. Hematoma surrounding the puncturing site was demonstrated in another case, but without any damage to the fetus. No maternal complications were noted in any of the cases described. Fourty two pregnancies were terminated as indicated by the results of the fetal blood analysis. Five of the neonates died, four of them were with congenital malformations. Only in one case intra uterine fetal death occured a short time after the cordocentesis. In this case a fetus of 25 gestational weeks with sever oligohydramnios and IUGR was diagnosed to suffer from metabolic acidosis (pH = 7.01). Seven cases in the total group described are still pregnant (all had cordocentesis more than a month before their inclusion in this study).

4 Discussion

Our preliminary experience with cordocentesis indicate that considering the advantages of the method the procedure itself is easy for routine practice. The success rate of the procedure is high and is similar to the results published by others [2, 5, 12]. Success of cordocentesis mainly depends on the reliability and technical as well as clinical skills of the performer. Another crucial factor for success is localization of the optimal site for the puncturing: one should rule out that the needle is indicated to a free loop of the umbilical cord. In cases of a placenta located in the posterior uterine wall and at that time the fetal presentation does not let resonable imaging of the puncturing site, one should not try unnecessary maneuvers and the cordocentesis should be postponed. Upon a spontaneous or externally induced change in anatomical position, it is possible to re-evaluate the optimal site for insertion of the needle. The needles used by others are 25 gauge [1], 22 gauge [2, 3] and 20 gauge [5, 18]. A low flexibility potential, found in the wider needles, is prefered for technical reasons. According to our experience a 21 gauge needle offers optimal flexibility and therefore is highly recomended by us. Those who prefer to use a 25 gauge needle must insert it via another wider needle used as a sleeve.

In our series the main indication for performing cordocentesis was the need for a rapid karyotyping. This indication is considered also by others [1, 2, 7, 12]. The use of fetal lymphocytes for chromosomal analysis offers a rapid and a reliable method for routine clinical demands. The availability of a rapid chromosomal analysis (two days) offers a considerable advantage in pregnancies of advanced gestational age. In those pregnancies it appears to be most important to have a rapid diagnosis where anatomical structural anomallies are associated with chromosomal malformations in up to 30% [1] and in cases of IUGR that were diagnosed early during the pregnancy [11]. Cordocentesis should be considered as the definitive method for establishing a diagnosis only in cases where the structural anomally is pre-selected and found to be prone for chromosomal defects, or in cases when the couple prefers to carry on the pregnancy in spite of the structural anomaly [9, 10, 19, 21, 23]. Prenatal diagnosis of genetic hematological disorders still awaits the establishment of standart fetal laboratory values in the different gestational weeks [1, 2, 3, 5, 7, 12, 14].

The metabolic status of the fetus should be considered in two major indications: 1. In acute fetal distress as expressed by pathological NST [2]. 2. In cases of chronic sub-optimal metabolic homeostasis which is demonstrated in IUGR and oligohydramnios [12, 15, 17, 18, 22]. The first indication is dominant in premature gestational age when the other monitoring facilities are known to yield high false positive. The second indication is important for a real time, rapid, reliable evaluation of the fetus in cases where a definite decision must be made wether to deliver immediately or to let the pregnancy go on. Upon the results obtained in cordocentesis for fetal real time metabolic status it was already offered to enrich maternal oxygen saturation, but primary results indicate that further investigation is required [4]. Among the intrauterine infections that can be easily diagnosed are: rubella, cmv and toxoplasmosis [4, 6, 13].

Cordocentesis is an invasive procedure, and therefore its risks and complications should be carefully evaluated. The main risk is the termination of the pregnancy because of fetal bleeding or intrauterine infections. We report of a relatively high incidence of this extreme complication. Other two large series in the literature report similar results. Daffos reports 1.1% intrauterine fetal death and 0.8% abortions [5]. Nicolaides reports 1% of termination of pregnancy as a direct complication of the procedure [4]. Weiner reports of 1400 cordocentesis per-

formed in four medical centers and mentions only 0.14% termination of the pregnancy as a complication of the procedure [23]. We agree the real risk of cordocentesis to be between 0.5% and 1% [17].

Cordocentesis, even though is a new technique, turns to play a major role in modern perinatology. The possibility of a direct rout to fetal blood vessels early during the pregnancy bears the potential of early diagnosis and treatment.

Abstract

Cordocentesis has been practiced as a diagnostical tool for prenatal diagnosis of intrauterine infections, hematological disorders, metabolic status of the fetus and rapid cytogenetic analysis. The performance of 198 cordocentesis is presented over 3 years of experience. A 21 gauge spinal needle is inserted via the optimal point on the maternal abdomen under real-time ultrasonic guidance into the insertion of the umbilical cord in the placenta. Successful cordocentesis were achieved in 98.5% of the cases. Termination of pregnancy was directly related to the procedure in only 1%. Hematoma surrounding the puncturing site was demonstrated in one case, but without damage to the fetus.

In our series the main indication for performing cordocentesis was the need for rapid karyotyping. The use of fetal lymphocytes for chromosomal analysis offers a rapid and a reliable method for routine clinical demands. The availability of a rapid chromosomal analysis offers a considerable advantage in pregnancies of advanced gestational age. In those pregnancies it appears to be most important to have a rapid diagnosis where anatomical structural anomalies are associated with chromosomal malformations in up to 30%. The metabolic status of the fetus is considered in either acute distress or in cases of suspected sub-optimal metabolic hemostasis, where IUGR or oligohydramnios are demonstrated.

Cordocentesis, even though is a new technique, turnes to play a major role in modern perinatology. The possibility of a direct rout to fetal blood vessels early during the pregnancy bears the tramendous potential of early diagnosis and treatment.

Keywords: Cordocentesis, fetal malformations, prenatal diagnosis.

Zusammenfassung

Nabelschnurpunktionen unter sonographischer Kontrolle in der pränatalen Diagnostik

Pränatal werden Nabelschnurpunktionen zur Diagnostik intrauteriner Infektionen, hämatologischer und metabolischer Störungen sowie zur raschen Karyotypisierung durchgeführt. Wir berichten über unsere Erfahrungen mit 198 Nabelschnurpunktionen innerhalb von drei Jahren. Unter Ultraschallkontrolle wird eine Spinalnadel (21 gauge) via mütterliches Abdomen in die Insertionsstelle der Nabelschnur in die Plazenta eingeführt. In 98.5% der Fälle war die Punktion erfolgreich. In 1% war die Schwangerschaftsbeendigung direkt Folge des Eingriffs. In einem Fall ließ sich ein Hämatom um die Punktionsstelle nachweisen, der Fetus nahm jedoch keinen Schaden.

In unserem Kollektiv war die häufigste Indikation zur Nabelschnurpunktion die rasche Karyotypisierung. Mit fetalen Lymphozyten kann eine schnelle und zuverlässige Chromosomenanalyse, wie sie die klinische Routine manchmal erfordert, erfolgen. Besonders in fortgeschrittenen Schwangerschaften bietet die rasche Karyotypisierung erhebliche Vorteile. Hier geht es um eine schnelle Diagnose, da in bis zu 30% strukturelle anatomische Anomalien mit Chromosomenstörungen assoziiert sind. Sowohl bei akutem Distress wie auch bei Verdacht auf Hämostasestörungen, IUGR und Oligohydramnion interessiert der metabolische Zustand des Feten.

Obwohl noch eine relativ neue Technik, scheint die Nabelschnurpunktion eine große Bedeutung in der modernen Perinatologie zu erlangen. Ein direkter Zugang zu den fetalen Blutgefäßen beinhaltet die Möglichkeit einer frühen Diagnostik und Behandlung in vielen Fällen.

Schlüsselwörter: Fetale Mißbildungen, Nabelschnurpunktionen, pränatale Diagnose.

Résumé

Diagnostic prénatal par cordocentèse écho-guidée

On a réalisé des cordocentèses comme instrument de diagnostic prénatal des infections intrautérines, des troubles hématologiques, de l'analyse du statut métabolique du fœtus et de l'analyse cytogénétique rapide. On présente la réalisation de 198 cordocentèses sur 3

ans. Une aiguille à ponction lombaire de 21 gauge est mise en place au niveau de l'insertion placentaire du cordon ombilical par le point optimal de l'abdomen maternel sous controle échographique en temps réel. Dans 98,5% des cas une cordocentèse a été réalisée avec succès. L'interruption de la grossesse secondaire directement à la technique ne représente qu'1% des cas. Dans un cas un hématome autour du lieu de ponction a été observé mais sans ennui pour le fœtus. Dans notre séride, l'indication principale de la cordocentèse est la nécessité d'un caryotype rapide. L'utilisation des lymphocytes fœtaux pour l'analyse chromosomique procure une méthode rapide et fiable pour les besoins clinique de routine. La disponibilité d'une analyse chromosomique rapide procure un avantage considérable pour les grossesses d'âge gestational avancé. Il apparaît de grande importance de disposer d'un diagnostic rapide pour les grossesses où des anomalies de structures anatomiques peuvent s'accompagner de malformations chromosomiques jusqu'à 30% des cas. Lorsqu'un RCIU ou un oligoamnios sont mis en évidence, on étudie l'équilibre métabolique du fœtus soit en cas de souffrance aigüe soit dans les cas où l'on suspecte un équilibre métabolique sub-optimal.
La cordocentèse, même s'il s'agit d'une nouvelle technique, est en train de jouer un rôle majeur dans la périnatologie moderne. La possibilité d'un accès direct aux vaisseaux sanguins du fœtus précocément aut cours de la grossesse procure la potentialité d'un diagnostic et d'un traitement précoce.

Mots-clés: Cordocentèse, malformations fœtales, diagnostic prénatal.

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